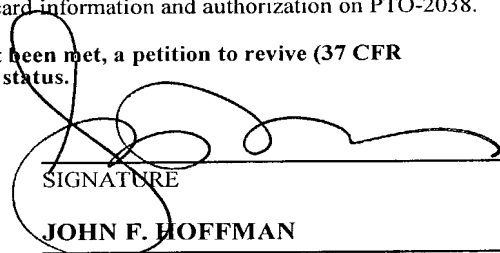


FORM PTO-1390 (Modified) (REV 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER VOI0226	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 10/070784	
INTERNATIONAL APPLICATION NO. PCT/EP00/08754		INTERNATIONAL FILING DATE 07 September 2000 (07/09/2000)		PRIORITY DATE CLAIMED 14 September 1999 (14/09/1999)	
TITLE OF INVENTION TRANSMISSION UNIT					
APPLICANT(S) FOR DO/EO/US KORNER, Tillmann et al.					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below. 4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)) 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). 10. <input checked="" type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)). 11. <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409). 12. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210). 					
Items 13 to 20 below concern document(s) or information included:					
<ol style="list-style-type: none"> 13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 15. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 16. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 17. <input type="checkbox"/> A substitute specification. 18. <input type="checkbox"/> A change of power of attorney and/or address letter. 19. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. 20. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 21. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 22. <input checked="" type="checkbox"/> Certificate of Mailing by Express Mail 23. <input checked="" type="checkbox"/> Other items or information: 					
Check No. <u>103292</u>					

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.101)		INTERNATIONAL APPLICATION NO		ATTORNEY'S DOCKET NUMBER	
10,070784		PCT/EP00/08754		VOI0226	
24. The following fees are submitted:				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00					
<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00					
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00					
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00					
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00					
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	20 - 20 =	0	x \$18.00	\$0.00	
Independent claims	1 - 3 =	0	x \$84.00	\$0.00	
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$890.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$890.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).				\$0.00	
TOTAL NATIONAL FEE =				\$890.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL FEES ENCLOSED =				\$890.00	
				Amount to be refunded	\$
				charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$890.00 to cover the above fees is enclosed.					
b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-0385 A duplicate copy of this sheet is enclosed.					
d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:					
John F. Hoffman BAKER & DANIELS 111 East Wayne Street, Suite 800 Fort Wayne, Indiana 46802			SIGNATURE  JOHN F. HOFFMAN NAME 26,280 REGISTRATION NUMBER MARCH 12, 2002 DATE		
TX: (260) 424-8000 FAX: (260) 460-1700					

10/070784 #4/a
JC10 Rec'd PCT/PTO 12 MAR 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of)
Tillmann Körner et al.)
Serial No.) Group:
Filed:)
Title: TRANSMISSION UNIT)

**PRELIMINARY AMENDMENT DELETING
MULTIPLE DEPENDENT CLAIMS**

Assistant Commissioner of Patents
Washington, DC 20231

Sir:

Prior to calculating the filing fee, please enter the following amendments to the application.

IN THE CLAIMS

In claim 3, line 1, delete "one of claims 1 or 2" and substitute therefor --claim 1--.

In claim 4, line 1, delete "one of claims 1 or 2" and substitute therefor --claim 1--.

In claim 6, line 1, delete "one of claims 4 or 5" and substitute therefor --claim 5--.

In claim 7, line 1, delete "one of claims 2 to 5" and substitute therefor --claim 2--.

In claim 8, line 1, delete "one of claims 1 to 7" and substitute therefor --claim 1--.

In claim 10, line 1, delete "one of claims 1 to 9" and substitute therefor --claim 1--.

In claim 11, line 1, delete "one of claims 1 to 10" and substitute therefor --claim 1--.

In claim 12, line 1, delete "one of claims 1 to 11" and substitute therefor --claim 1--.

In claim 13, line 1, delete "one of claims 1 to 11" and substitute therefor --claim 1--.

In claim 14, line 1, delete "one of claims 12 or 13" and substitute therefor --claim 12--.

Please add the following new claims:

17 --15. Transmission unit according to claim 2, characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in an axial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.

18 --16. Transmission unit according to claim 2, characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the

transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in a radial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.

19 17. Transmission unit according to claim 5 characterized by the following characteristics:

the output (15) of transmission basic unit (25) consists of the annulus (26) of the epicyclic gear train (27);

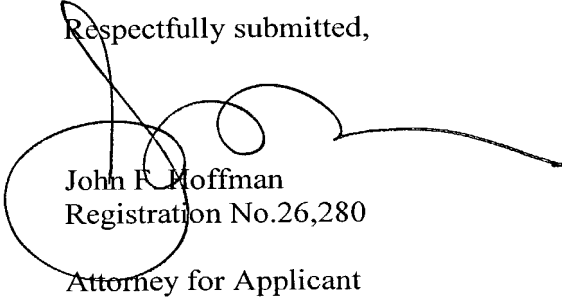
the driving elements consist of an exterior toothing (28) on the first bevel gear (8) complementary to the interior toothing (29) of the annulus (26), where annulus (26) has an elongation in an axial direction, which does not connect to the pinion gears (13) and where the first bevel gear (8) has a segment (35) with no beveled toothing.

20 18. Transmission unit according to claim 3 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

21 19. Transmission unit according to claim 4 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

22 20. Transmission unit according to claim 5 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.--

Respectfully submitted,


John F. Hoffman
Registration No. 26,280

Attorney for Applicant

JFH/pmp/#225351

BAKER & DANIELS
111 East Wayne Street, Suite 800
Fort Wayne, IN 46802

Date: March 12, 2002

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

1. Transmission unit
 - 1.1 with a transmission input shaft (E) and a transmission output shaft (A), and a transmission basic unit (25) situated between transmission input shaft (E) and transmission output shaft (A), which is connected to an angular drive (4);
 - 1.2 where the angular drive (4) includes at least a bevel gear drive (3) with a first bevel gear (8) and a second bevel gear (9), where the second bevel gear (9) is solidly connected to the transmission output shaft, at least indirectly;
 - 1.3 with a transmission housing (5) that includes at least a transmission base housing (6) that covers the transmission basic element (25), and which can be connected to a housing cover formed by a transmission housing component (7), which covers the angular drive (4) at least in part;

characterized by the following characteristics:
 - 1.4 the first bevel gear (8) of angular drive (4) and a transmission element of the basic transmission unit (25), which constitutes the output (15) of basic transmission unit (25), have a direct and solid connection and are located in immediate proximity to each other;
 - 1.5 the basic transmission unit (25) does not include any elements capable of generating axial forces to act against the housing cover on the housing wall;
 - 1.6 the solid connection consists of complementary driving elements, which may be brought to bear upon each other, on the transmission elements functioning as output (15) and the first bevel gear (8);
 - 1.7 the first bevel gear (8) of angular drive (4) is supported within the transmission housing component (7).
2. Transmission unit according to claim 1 characterized by the following characteristics:
 - 2.1 the transmission basic unit (25) includes at least one epicyclic gear train (27) with at least one annulus (26), one sun gear (12), pinion gears (13) and a bar (14) or a cylindrical gear pair;
 - 2.2 the output (15) of transmission basic unit (25) consists of an element of the epicyclic gear train (27) or the cylindrical gear pair.
3. Transmission unit according to [one of claims 1 or 2] claim 1 characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms

the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in an axial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.

4. Transmission unit according to [one of claims 1 or 2] claim 1 characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in a radial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.
5. Transmission unit according to claim 4 characterized by the following characteristics:
 - 5.1 the driving elements are positioned in the area of the interior circumference of the transmission element, which forms output (15);
 - 5.2 the driving elements complementary to it are positioned on the first bevel gear (8) in the area of its external circumference (16).
6. Transmission unit according to [one of claims 4 or 5] claim 4 characterized by the following characteristics:
 - 6.1 the output (15) of transmission basic unit (25) consists of the annulus (26) of the epicyclic gear train (27);
 - 6.2 the driving elements consist of an exterior toothing (28) on the first bevel gear (8) complementary to the interior toothing (29) of annulus (26), where annulus (26) has an elongation in an axial direction, which does not connect to the pinion gears (13) and where the first bevel gear (8) has a segment (35) with no beveled toothing.
7. Transmission unit according to [one of claims 2 to 5] claim 2 characterized by having an output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.
8. Transmission unit according to [one of claims 1 to 7] claim 1 characterized by the following characteristics:

the transmission housing component (7), which encloses the transmission unit at least in the area of the angular drive (4), is designed such that, for all theoretically possible

17. Transmission unit according to claim 5 characterized by the following characteristics:

the output (15) of transmission basic unit (25) consists of the annulus (26) of the epicyclic gear train (27);

the driving elements consist of an exterior toothing (28) on the first bevel gear (8) complementary to the interior toothing (29) of the annulus (26), where annulus (26) has an elongation in an axial direction, which does not connect to the pinion gears (13) and where the first bevel gear (8) has a segment (35) with no beveled toothing.

18. Transmission unit according to claim 3 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

19. Transmission unit according to claim 4 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

20. Transmission unit according to claim 5 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.--

VERSION AS CHANGED
IN THE CLAIMS

1. Transmission unit
 - 1.1 with a transmission input shaft (E) and a transmission output shaft (A), and a transmission basic unit (25) situated between transmission input shaft (E) and transmission output shaft (A), which is connected to an angular drive (4);
 - 1.2 where the angular drive (4) includes at least a bevel gear drive (3) with a first bevel gear (8) and a second bevel gear (9), where the second bevel gear (9) is solidly connected to the transmission output shaft, at least indirectly;
 - 1.3 with a transmission housing (5) that includes at least a transmission base housing (6) that covers the transmission basic element (25), and which can be connected to a housing cover formed by a transmission housing component (7), which covers the angular drive (4) at least in part;
characterized by the following characteristics:
 - 1.4 the first bevel gear (8) of angular drive (4) and a transmission element of the basic transmission unit (25), which constitutes the output (15) of basic transmission unit (25), have a direct and solid connection and are located in immediate proximity to each other;
 - 1.5 the basic transmission unit (25) does not include any elements capable of generating axial forces to act against the housing cover on the housing wall;
 - 1.6 the solid connection consists of complementary driving elements, which may be brought to bear upon each other, on the transmission elements functioning as output (15) and the first bevel gear (8);
 - 1.7 the first bevel gear (8) of angular drive (4) is supported within the transmission housing component (7).
2. Transmission unit according to claim 1 characterized by the following characteristics:
 - 2.1 the transmission basic unit (25) includes at least one epicyclic gear train (27) with at least one annulus (26), one sun gear (12), pinion gears (13) and a bar (14) or a cylindrical gear pair;
 - 2.2 the output (15) of transmission basic unit (25) consists of an element of the epicyclic gear train (27) or the cylindrical gear pair.
3. Transmission unit according to claim 1 characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the

- 8-

- the gear ratio i is essentially constant
 - and the outside diameters of the various bevel gears are essentially constant,
- it has the same exterior dimensions, where various position angles for the transmission output shaft (A) may be realized by an exchangeable apparatus to support the second bevel gear (9) and/or the transmission output gear (A).
9. Transmission unit according to claim 8 characterized by having transmission housing component (7) consist of a single housing.
 10. Transmission unit according to claim 1 characterized by having the transmission basic unit (25) consist of a hydrodynamic and a mechanical transmission component.
 11. Transmission unit according to claim 1 characterized by the possibility that the angular drive (4) and the housing component, which covers it at least partially, can be combined to a modular unit.
 12. Transmission unit according to claim 1 characterized by having straight toothing in the toothing of the connected bevel gears.
 13. Transmission unit according to claim 1 characterized by having diagonal toothing in the toothing of the connected bevel gears of the bevel gear drive.
 14. Transmission unit according to claim 12 characterized by having identical height of the toothing of the bevel gears of the bevel gear drive.
 - 15. Transmission unit according to claim 2, characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in an axial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.
 16. Transmission unit according to claim 2, characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in a radial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.
 17. Transmission unit according to claim 5 characterized by the following characteristics:

the output (15) of transmission basic unit (25) consists of the annulus (26) of the epicyclic gear train (27);

the driving elements consist of an exterior toothing (28) on the first bevel gear (8) complementary to the interior toothing (29) of the annulus (26), where annulus (26) has an elongation in an axial direction, which does not connect to the pinion gears (13) and where the first bevel gear (8) has a segment (35) with no beveled toothing.

18. Transmission unit according to claim 3 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

19. Transmission unit according to claim 4 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.

20. Transmission unit according to claim 5 characterized by having and output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.--

Transmission Unit

[0001] The invention concerns a transmission unit, specifically with the characteristics as described in the preamble to Claim 1.

Transmission units are known in a variety of different embodiments. One of the possible classification systems for transmissions relies the method chosen for speed / torque conversion. For example, the speed / torque transmission may be purely mechanical or may be combined with other conversion possibilities. Because the requirement of universal application of a transmission unit, i.e. the characteristics of its incorporation into vehicles, has become increasingly significant, angular drives are used to link output in various angles to the transmission input shaft in such transmission applications. A significant problem of this method is that such transmissions constructed as combinations of units will tend to be very large, due to the required incorporation of the elements of the angular drive and specifically the element connected on the output end of the unit; this size, in turn, leads to difficulty in incorporating the unit into vehicles, because the space available for the transmission unit is typically very limited.

[0002] Thus, the invention is based on the task of developing a transmission unit for use in vehicles with mechanical or combined torque transmission in such a manner that such a unit minimizes construction expense and space.

[0003] The solution according to this invention is characterized by the characteristics of Claim 1. Advantageous embodiments are shown in the dependant claims.

[0004] The transmission unit includes a transmission input shaft and a transmission output shaft separated by a mechanical transmission unit. The mechanical transmission unit includes a transmission basic unit, which is also called base transmission, and an angular drive with a bevel gear drive, consisting of a first bevel gear and a second bevel gear, where the second bevel gear can be coupled to the transmission output shaft in an at least indirectly rotationally fixed manner, while the first bevel gear of this invention is in the immediate proximity of the output of the transmission basic unit and is directly coupled with this shaft, such that there is no intervening separate connecting shaft between the output shaft and the first bevel gear. Thus, the first bevel gear is not mounted on an extension of the shaft or is rotationally coupled with a shaft, which supports the transmission element that

functions as output or which is connected to the same. Thus, the arrangement of shafts in the transmission basic unit is not modified. The transmission housing consists of at least one housing, which surrounds the transmission basic unit, which can be connected to a housing cover in the form of a transmission housing component that surrounds the angular drive at least in part. Thus, the transmission basic unit of the invention does not include elements that generate axial force that pushes against the housing cover on the housing wall, such as a piston that operates in the axial direction.

[0005] In a particularly advantageous embodiment, the transmission basic unit includes at least one cylindrical gear pair with two matching cylindrical gears or an epicyclic gear train, which includes at least one sun gear, one annulus, pinion gears and a bar, where one element of these transmission elements constitutes the output of the transmission basic unit. The output of the epicyclic gear train will then be formed, for example, by the annulus, the bar or the sun gear of the epicyclic gear train or by the spur gear matched to the pinion in the cylindrical gear pair. The first bevel gear forms here the input of the angular drive directly. There are essentially the following possibilities to achieve a rotationally fixed connection between the transmission element of the transmission basic unit that constitutes the output and the first bevel gear:

- a. positive lock
- b. non-positive lock
- c. a combination of positive and non-positive lock

The connection between positive and non-positive lock is made in the simplest case by mutually complementary driving elements on the transmission element that forms the output of the transmission basic unit and the first bevel gear, which may be brought into active connection. These are most advantageously situated in equal distances between the transmission element and the first bevel gear, viewed in the direction of the perimeter. The driving elements may here be embodied as claws, which insert into specifically designed recesses, or appropriately formed toothing.

[0006] There are here essentially two basic configurations:

1. Inclusion of driving elements on the first bevel gear and/or the transmission unit, which forms the output of the transmission basic unit, and matching complementary driving elements, such as driving recesses on the transmission element, which forms the output of the transmission basic unit, and/or the first

bevel gear seen in an axial direction relative to the direction of the transmission axle, specifically the transmission input axle, viewed in the installed position.

2. Inclusion of driving elements on the first bevel gear and/or the transmission unit, which forms the output of the transmission basic unit, and matching complementary driving elements, such as driving recesses on the transmission element, which forms the output of the transmission basic unit, and/or the first bevel gear seen in a radial direction relative to the direction of the transmission axle, specifically the transmission input axle, viewed in the installed position.

[0007] The driving elements and the associated recesses or complementary driving elements, which may also be designed as recesses, are here most advantageously situated in the area of the circumference of the first bevel gear and/or the transmission unit that forms the output of the transmission basic unit. The inclusion of the driving elements is accomplished here as follows:

1. On the inner circumference of the driving element, which forms the output, and the complementary driving element on the first bevel gear on the outer circumference of the first bevel gear, or
2. On the outer circumference of the driving element, which forms the output, and the complementary driving element on the inner circumference of the first bevel gear.

[0008] The two specified possibilities have the advantage that the realization of the rotationally solid connection between the angular drive and the output of the transmission basic unit is possible without any additional fastening measures, but simply by pushing it on, where the secure connection in an axial direction is generated simply by the linkage of the housing of the angular drive, where the first bevel gear is supported, and the housing of the basic transmission. This type of connection of the angular drive to the transmission basic unit is characterized by a very small space requirement, which has a particularly positive influence on the total length of the transmission unit.

[0009] An alternative embodiment of the invention could combine the angular drive, its housing and the required supports as a complete pre-fabricated unit with a transmission basic unit to an entire transmission unit. The possibility of removing the angular drive from the transmission basic unit as a modular unit creates the advantage that the transmission basic unit may be tested by itself even in the absence of the angular drive. However, the precondition is here that the transmission basic unit is

designed such that its working elements for the various transmission elements to realize the several speed increments do not exert any axial force on the possible closure or housing cover for the basic transmission, but that these axial forces are already dissipated in the housing by an appropriate design. This means that the transmission unit is free of elements to generate axial forces that act directly on the transmission housing cover in the vicinity of the output of the transmission basic unit and the angular drive.

[0010] An especially advantageous embodiment realizes the solid connection of the first bevel gear with the annulus of a mechanical transmission unit that forms the output of the transmission basic unit. This embodiment may use particularly large diameters of the first bevel gear. This leads to a particularly short and compact design, given the resulting design of the second bevel gear, which connects to the first bevel gear.

[0011] The insertion and removal of the second bevel gear, which is linked to the output shaft, is preferably done by way of the level of the flange of the entire angular drive. The position of the angular drive elements is independent of the unit suspension of the output, i.e. the transmission output shaft, which is why the supports do not need to be adjusted at the flange connection of the angular drive.

[0012] The connection between the basic housing of the transmission basic unit and the housing of the angular drive to form the entire transmission unit is normally handled likewise by positive and/or non-positive locks. The housing for the angular drive may be either a single piece or, preferably, it may consist of multiple components.

[0013] In an additional embodiment of the invention, a set of angular drives in the form of bevel gear drives with a first bevel gear and a second bevel gear, where the gear ratio for all theoretically possible angles between the input of the angular drive and the output of the angular drive is constant and where the outside diameter of the individual bevel gears, namely the first and second bevel gears, are also held essentially constant, can be assigned to a single housing with identical external dimensions. The adjustment in the position of the output shaft, which is required by the various output angles, and the position of the supports will be realized most advantageously by support units that can be integrated into the housing and can be exchanged. Given the specified preconditions, i.e. different output angles for a set of transmission units with angular drives, where the gear ratio is essentially constant for

all theoretically possible angles and where the diameter of the individual elements of the angular drive is essentially also constant with the set, the intersections of the flank lines with the transmission symmetry axis S_G will cover a specific area in the axial direction for various angles, if viewed from the transmission symmetry axis S_G . This area determines the design of the transmission housing. In order to have a uniform entire transmission housing, including the housing for the angular drive, i.e. in order to use one transmission basic unit in multiple transmission applications with the same transmission housing, the housing surrounding the angular drive will be manufactured in such a standard design that it is suited to house all theoretically possible or desirable angular drives. The limits are pre-specified in this instance. However, generally the basic housing of the transmission housing is designed for the theoretically desirable case that the intersection of the flank lines of the bevel gears, when inserted into the transmission, is in close proximity to the base of the transmission housing, viewed in an axial direction. For example, this may be the situation for an angular drive with an angle of 90° or even more than 90° . The precise determination should be limited to what is theoretically feasible, where the practical construction feasibility also needs to be considered. It is most advantageous to design a housing suitable for angular drives of 60° to 90° . The outside contours of the transmission housing for various angular drives with the essentially constant gear ratio i and an identical outside diameters d_A of the individual bevel gears will remain constant, while the adjustment to the specific angular drives is made by the means to support the second bevel gear, which forms the output of the transmission unit. Among others, this has the advantage that the connection elements for the housing surrounding the angular drive, at least in part, and the housing for the transmission basic unit for the entire set will have the same size, regardless of the size of the angle.

[0014] All kinds of toothings are possible for the toothings of the bevel gears.

[0015] In another embodiment of the invention, the cooling features, which are otherwise flanged to the cover of the basic transmission without an angular drive, are sited at the end of the angular drive. The required connecting lines will then no longer be handled by hoses, but are engraved as channels in the housing or may be incorporated there.

[0016] In a design of the angular drive with a single unit housing, i.e. with exchangeable interior supports and removable support of the second bevel gear on the transmission output shaft, i.e. the shaft that forms the output of the angular drive, it is

feasible to design the second bevel gear in a different manner than for conventional embodiments. Here the transmission housing unit, which surrounds the angular drive, is first separated from the transmission basic unit and simultaneously the solid connection between the second bevel gear and the transmission output shaft is severed, so that the second bevel gear is rolled out of the cavity of the housing surrounding the angular drive, once the transmission output shaft is removed from the transmission housing. This makes it possible to shift the entire bevel gear drive further in the axial direction into the interior of the transmission housing, i.e. in the direction of the transmission input shaft, because an opening to remove the second bevel gear in the direction of the symmetrical axis of the transmission output shaft or on the housing wall with a feed-through for the transmission output shaft is no longer required. The designed feed-through in the transmission housing will then need to be sized only for the feed-through of the transmission output shaft.

[0017] The solution according to the invention is suited for any design of the transmission unit. Here it may be, for example, a purely mechanical transmission unit or a hydrodynamic-mechanical compound transmission.

[0018] The solution of this invention is explained by use of Figures, which show the following:

Fig. 1 shows a schematically simplified view of a transmission unit according to the design of the invention in an axial direction;

Fig. 2a and 2b

show a schematically simplified view of the support of transmission output shaft A for two alternative angles between the transmission input shaft and the transmission output shaft;

Fig. 3 shows the possibilities for adding the angular drive in a simplified view corresponding to view A in Figures 1 or 2;

Fig. 4.1 – 4.4 show the possibilities to insert the transmission unit in bus propulsion systems with alternative requirements.

[0019] Fig. 1 shows the connection, which is designed according to the invention, of an angular drive 4 to the transmission basic unit 25, by reference to a segment of an axial cross section of transmission unit 1 in a schematically simplified view. The transmission unit contains a transmission input shaft E and at least one transmission output shaft A. The transmission input shaft E and the transmission output shaft A are situated such that their theoretical axes of rotation R_E and R_A

intersect at an angle. The transmission unit 1 contains at least one transmission basic unit 25, which is situated between the transmission input shaft E and the transmission output shaft A. The transmission basic unit 25 includes a mechanical transmission component 2 and a bevel gear drive 3 designed as an angular drive 4, which is connected to the transmission output shaft A. The transmission unit 1 also contains a transmission housing 5, which consists of at least two parts. In the present case, this includes at least one transmission base housing 6 and a transmission housing component 7, which surrounds the angular drive at least in part and which can be connected to transmission base housing 6. However, the transmission housing component 7 may consist of multiple components.

[0020] The angular drive 4, which consists of the bevel gear drive 3, contains at least two connected bevel gears, namely a first bevel gear 8 and a second bevel gear 9. The first bevel gear 8 is mounted coaxially to the transmission input shaft E. The second bevel gear 9, which has a solid connection to transmission output shaft A, is mounted at a certain angle to the first bevel gear 8.

[0021] The theoretical axes of rotation of the various bevel gears or their axes of symmetry, which correspond to the theoretical axes of rotation of the transmission input axis R_E and the transmission output axis R_A , intersect in a point 10, which lies on the axis of symmetry of transmission unit 1. If the flank lines F of the toothing of the various bevel gears are projected onto a common plane E, they intersect with the transmission axis of symmetry S_G in this same point. The flank lines are identified here as F_{81} , F_{82} , and F_{91} , F_{92} . It is most advantageous, if the toothing of the various bevel gears consists of straight line toothing. However, embodiments with diagonal toothing or arced toothing, where the flank lines are arcs, are also conceivable.

[0022] The arcs in bevel gears with arced flank lines may be circles, involutes, or epicycloids. In the case depicted here, the bevel gears have a constant tooth height Z_{H8} and Z_{H9} . The following description is based on the straight toothing shown in Fig. 1. This description applies by analogy to other toothing.

[0023] Angular drives 4 are designed for alternative angles between the transmission input shaft E and the transmission output shaft A for a specific transmission basic unit 25, where these angular drives are designed such that the individual flank lines for straight toothing or flank lines projected onto a plane with the transmission axis S_G may form alternative angles with the transmission axis S_G . The various angular drives 4, which are suited theoretically for housing component 7,

designed for alternative angles between the transmission input shaft E and the transmission output shaft A, which are characterized on the one hand by an essentially constant gear ratio between the individual bevel gears 8 or 9 and on the other hand by essentially constant external diameters of the individual bevel gears 8 or 9, will exhibit intersections of their flank lines F_{81} , F_{82} , F_{91} , F_{92} with the transmission axis S_G on a certain surface in an axial direction on transmission axis S_G . This surface determines the design of transmission housing 5 or the housing component 7 surrounding the angular drive. In order to achieve as uniform a housing 5 as possible, including the transmission housing component 7, for a transmission basic unit 1 with various output characteristics, i.e. with various angles between transmission output axis A and transmission input axis E, the second transmission housing component 7 is standardized such that it is capable of housing all theoretically possible or desired angular drives 4, where the angle between transmission input axis E and transmission output axis A acts as the only criteria of distinction, while the gear ratio and the outside diameter of the bevel gears are held constant for the various theoretically possible angles. The basic housing of transmission housing component 7 will therefore be designed for the two theoretical extreme cases, namely where the intersection 10 of the flank lines of bevel gears 8 or 9 of the bevel gear drive 3 is closest to transmission housing 5 and transmission housing component 7 in the axial direction or is furthest away from them. For example, the first extreme case may be the case of an angular drive 4 of 90° or even an angle of more than 90° . It is not necessary to make an exact determination, but it should remain in the theoretically possible range, with consideration given to the limitations imposed by production requirements. However, it is most advantageous to target for an angular drive with an angle between transmission input axis E and transmission output axis A in the range of 90° to $<180^\circ$, where the angle $<180^\circ$ identifies the second extreme case. As was mentioned earlier, the outside dimensions for various angular drives 4 with essentially identical gear ratios i and the same outside diameters d_A of the bevel gears 8 or 9 remain constant, while the adjustment to various angular drives, specifically the position of the supports, is accomplished through design or treatment of the inner surfaces of the housing, specifically housing component 7.

[0024] The tight linkage of the first bevel gear 8 and the elements of the mechanical transmission component 2, as shown in this invention, may be accomplished by various means. The preferred embodiment shown here was chosen

from the remaining transmission housing 5, then to separate the transmission output shaft A from bevel gear 9 and to roll the same sideways out of the cavity 11 formed within transmission housing component 7. This makes it feasible to move the entire bevel gear drive 3 in an axial direction further into the interior of transmission housing component 7, because the transmission housing component 7 is no longer limited in size by the size of feed-through 23 of transmission output shaft A to a size that would also allow removal of the second bevel gear 9 in this direction.

[0031] Other possibilities to remove the second bevel gear 9 require a corresponding design of opening 23. This may be elliptical in an alternative embodiment for the feed-through of transmission output shaft A. The maximum dimension corresponds here to the outside diameter d_A of the second bevel gear 9. The connection between transmission output shaft A and the second bevel gear 9 is severed first during removal and the second bevel gear 9 is led to the elliptical opening by tipping.

[0032] The design of transmission housing 5 as shown in Fig. 1 to 3, particularly the design of transmission housing component 7, makes it feasible to use a common housing to enclose various angular drives 4. The output angle is determined only by the design or the assembly and finishing of the interior surfaces in the vicinity of the second bevel gear, which is connected to transmission output shaft A. The division of the housing into a transmission base housing 6 and a so-called transmission housing component 7 makes it feasible to move the angular drive 4 in an axial direction further towards the transmission input shaft compared to conventional embodiments. This very short shape thus applies across the plane of the connection of the entire angular drive. The described preferred embodiment enables a free design of the output side, which results in a short size that saves material. The transmission base unit may be tested without angular drive 4.

[0033] Fig. 4 exemplifies potential applications of a transmission unit 1 according to the invention with a uniform housing, consisting of transmission base housing 6 and transmission housing component 7, by means of examples. Here the term "transmission housing" should not be interpreted to require complete coverage, but the housing may have openings, which may in turn be closed by lid-shaped elements.

[0034] Fig. 4.1 shows the use of the transmission unit 1 according to the invention in a bus propulsion system with a transverse motor 30 to drive an axle 31,

WO 01/20195

PCT/EP00/08754

Listing of Reference Identifications

E	Transmission input shaft
A	Transmission output shaft
1	Transmission unit
2	Mechanical transmission component
3	Bevel gear drive
4	Angular drive
5	Transmission housing
6	Transmission base housing
7	Transmission housing component
8	First bevel gear
9	Second bevel gear
10	Intersection of axes of symmetry
11	Cavity
12	Sun gear
13	Pinion gear
14	Bar
15	Output of transmission
16	Exterior circumference of first bevel gear
17	Interior of annulus
18	Driving elements
19	Driving elements
23	Feed-through
25	Transmission basic unit
26	Annulus
28	Exterior toothing
29	Interior toothing
33	Solid connection
34	Pinion gears
35	Second segment of bevel gear
36	Support
37	Axis

WO 01/20195

PCT/EP00/08754

F_{81} , F_{82} , and F_{91} , F_{92} Flank lines of the toothing of the bevel gears

Claims

1. Transmission unit
 - 1.1 with a transmission input shaft (E) and a transmission output shaft (A), and a transmission basic unit (25) situated between transmission input shaft (E) and transmission output shaft (A), which is connected to an angular drive (4);
 - 1.2 where the angular drive (4) includes at least a bevel gear drive (3) with a first bevel gear (8) and a second bevel gear (9), where the second bevel gear (9) is solidly connected to the transmission output shaft, at least indirectly;
 - 1.3 with a transmission housing (5) that includes at least a transmission base housing (6) that covers the transmission basic element (25), and which can be connected to a housing cover formed by a transmission housing component (7), which covers the angular drive (4) at least in part;
characterized by the following characteristics:
 - 1.4 the first bevel gear (8) of angular drive (4) and a transmission element of the transmission basic element (25), which constitutes the output (15) of transmission basic element (25), have a direct and solid connection and are located in immediate proximity to each other;
 - 1.5 the transmission basic element (25) does not include any elements capable of generating axial forces to act against the housing cover on the housing wall.
2. Transmission unit according to claim 1 characterized by the following characteristics:
 - 2.1 the transmission basic unit (25) includes at least one epicyclic gear train (27) with at least one annulus (26), one sun gear (12), pinion gears (13) and a bar (14) or a cylindrical gear pair;
 - 2.2 the output (15) of transmission basic unit (25) consists of an element of the epicyclic gear train (27) or the cylindrical gear pair.
3. Transmission unit according to one of claims 1 or 2 characterized by having a solid connection consisting of complementary driving elements, which may be brought to bear upon each other, on the transmission elements functioning as output (15) and the first bevel gear (8).

4. Transmission unit according to one of claims 2 or 3 characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in an axial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.
5. Transmission unit according to one of claims 2 or 3 characterized by having driving elements on the first bevel gear (8) and/or on the transmission element that forms the output (15) of the transmission basic unit (25) and the corresponding driving elements on the transmission element that forms the output (15) of the transmission basic unit (25) and/or the first bevel gear (8), which are oriented and positioned in a radial direction relative to the position of the transmission axle, specifically the transmission input shaft (E), as installed.
6. Transmission unit according to claim 5 characterized by the following characteristics:
 - 6.1 the driving elements are positioned in the area of the interior circumference of the transmission element, which forms the output (15);
 - 6.2 the driving elements complementary to it are positioned on the first bevel gear (8) in the area of its external circumference (16).
7. Transmission unit according to one of claims 4 to 6 characterized by the following characteristics:
 - 7.1 the output (15) of transmission basic unit (25) consists of the annulus (26) of the epicyclic gear train (27);
 - 7.2 the driving elements consist of an exterior toothing (28) on the first bevel gear (8) complementary to the interior toothing (29) of annulus (26), where annulus (26) has an elongation in an axial direction, which does not connect to the pinion gears (13) and where the first bevel gear (8) has a segment (35) with no beveled toothing.

8. Transmission unit according to one of claims 2 to 6 characterized by having an output (15) of the transmission basic unit (25) with a transmission element consisting of a sun gear (12) or a bar (14) of the epicyclic gear train (27) or a cylindrical gear.
9. Transmission unit according to one of claims 1 to 8 characterized by the following characteristics:
the transmission housing component (7), which encloses the transmission unit at least in the area of the angular drive (4), is designed such that, for all theoretically possible angular drives with the following characteristics:
 - the gear ratio i is essentially constant and the outside diameters of the various bevel gears are essentially constant,it has the same exterior dimensions, where various position angles for the transmission output shaft (A) may be realized by an exchangeable apparatus to support the second bevel gear (9) and/or the transmission output gear (A).
10. Transmission unit according to claim 9 characterized by having transmission housing component (7) consist of a single housing.
11. Transmission unit according to one of claims 1 to 10 characterized by having the transmission basic unit (25) consist of a hydrodynamic and a mechanical transmission component.
12. Transmission unit according to one of claims 1 to 11 characterized by the possibility that the angular drive (4) and the housing component, which covers it at least partially, can be combined to a modular unit.
14. Transmission unit according to one of claims 1 to 13 characterized by having straight toothing in the toothing of the connected bevel gears.
15. Transmission unit according to one of claims 1 to 13 characterized by having diagonal toothing in the toothing of the connected bevel gears of the bevel gear drive.

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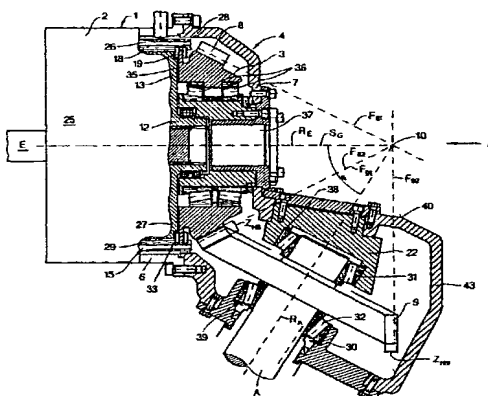
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[Fortsetzung auf der nächsten Seite]

(54) Title: TRANSMISSION UNIT

(54) Bezeichnung: GETRIEBEBAUEINHEIT



(57) Abstract: The invention relates to a transmission unit (1) comprising a transmission input shaft (F) and a transmission output shaft (A) as well as a transmission basic unit (25), which is arranged between the transmission input shaft and the transmission output shaft, and which is coupled to an angular drive (4). The angular drive comprises at least one bevel gear step (3) with a first bevel gear (8) and a second bevel gear (9), whereby the second bevel gear can be coupled to the transmission output shaft in an at least indirect rotationally fixed manner. The transmission unit is enclosed by a transmission case (5), which comprises at least one basic transmission case (6) that encloses the transmission basic unit, and which can be connected to a case cover provided in the form of a transmission case part (7) that at least partially encloses the angular drive. In order to realize a short overall length of the transmission unit, the invention provides that the first bevel gear of the angular drive and a transmission element which is part of the basic transmission unit and which forms the output (15) of the basic transmission unit are directly interconnected in a rotationally fixed manner and are arranged next to one another in a spatially close manner. As a result, the transmission basic unit does not require elements for generating an axial force that supports the case cover on the wall of the case.

(57) Zusammenfassung: Die Erfindung betrifft eine Getriebebaueinheit (1) mit einer Getriebeeingangswelle (F) und einer Getriebeausgangswelle (A) und einer, zwischen Getriebeeingangswelle und Getriebeausgangswelle angeordneten Getriebegrundbaueinheit (25), welche mit einem Winkeltrieb (4) gekoppelt ist. Der Winkeltrieb umfaßt wenigstens eine Kegelradstufe (3) mit einem ersten Kegelrad (8) und einem zweiten Kegelrad (9), wobei das zweite Kegelrad mit der Getriebeausgangswelle wenigstens mittelbar drehfest koppelbar

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WO 01/20195 A1



(81) **Bestimmungsstaaten** (*national*): JP, US.

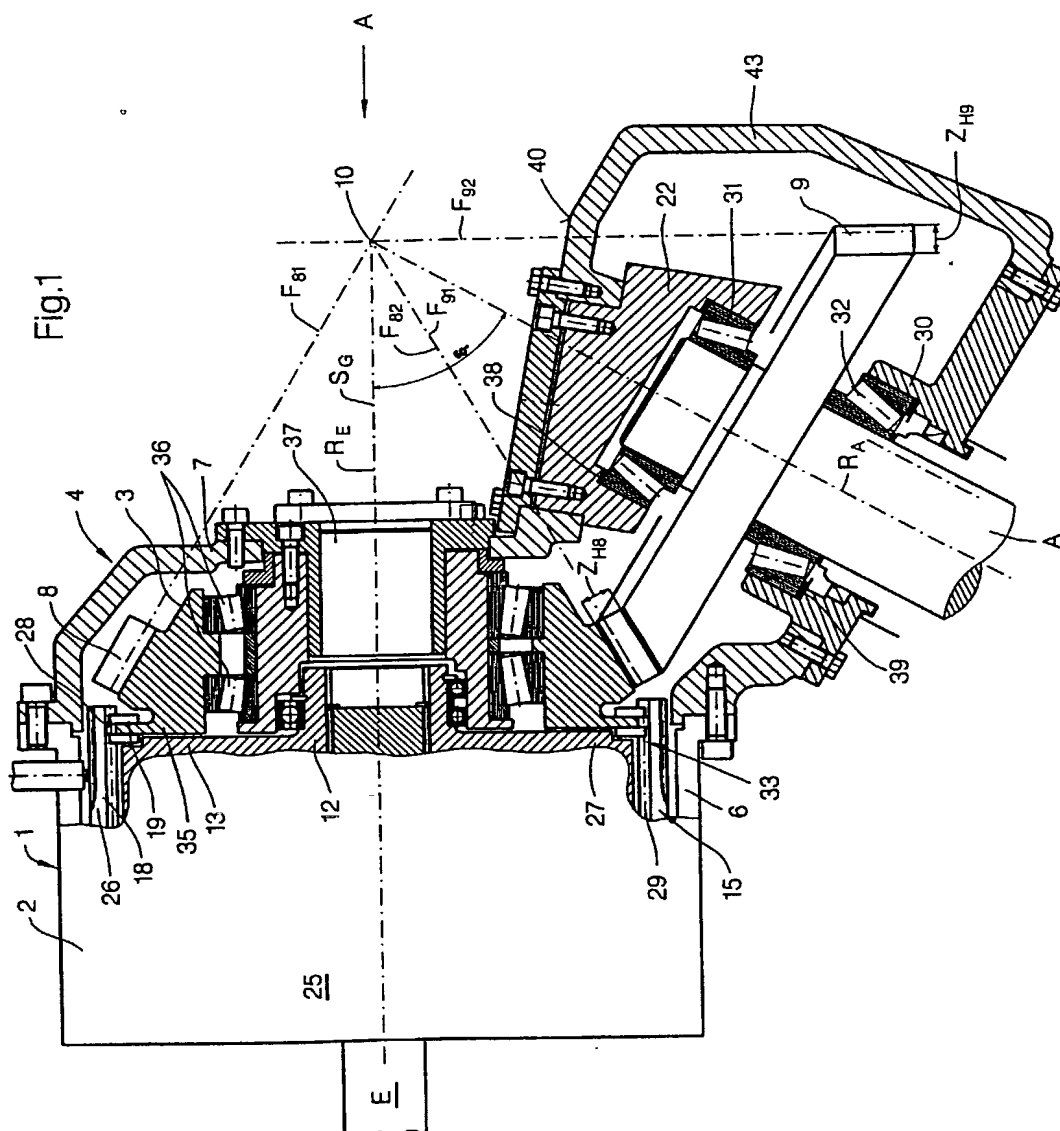
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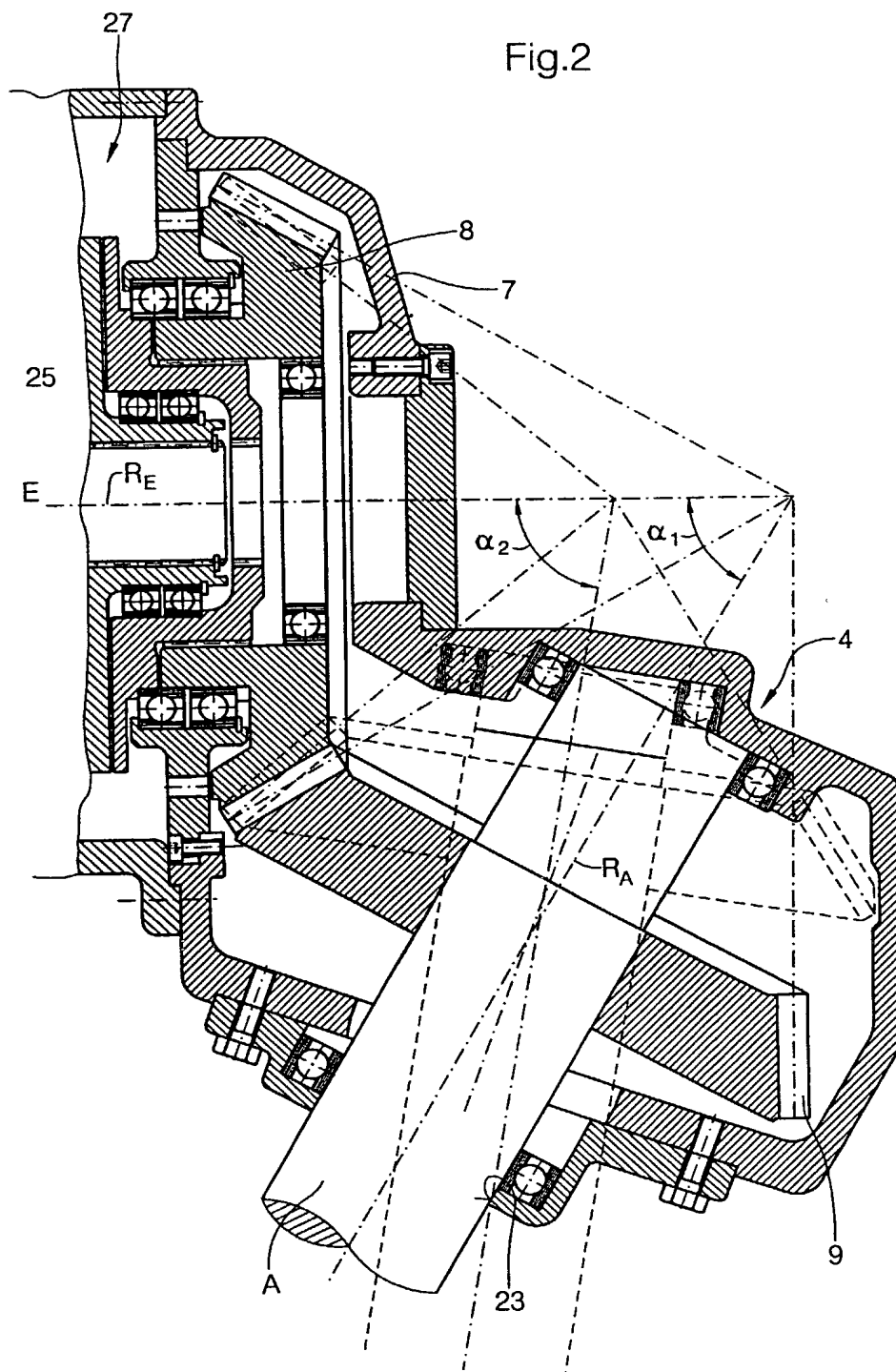
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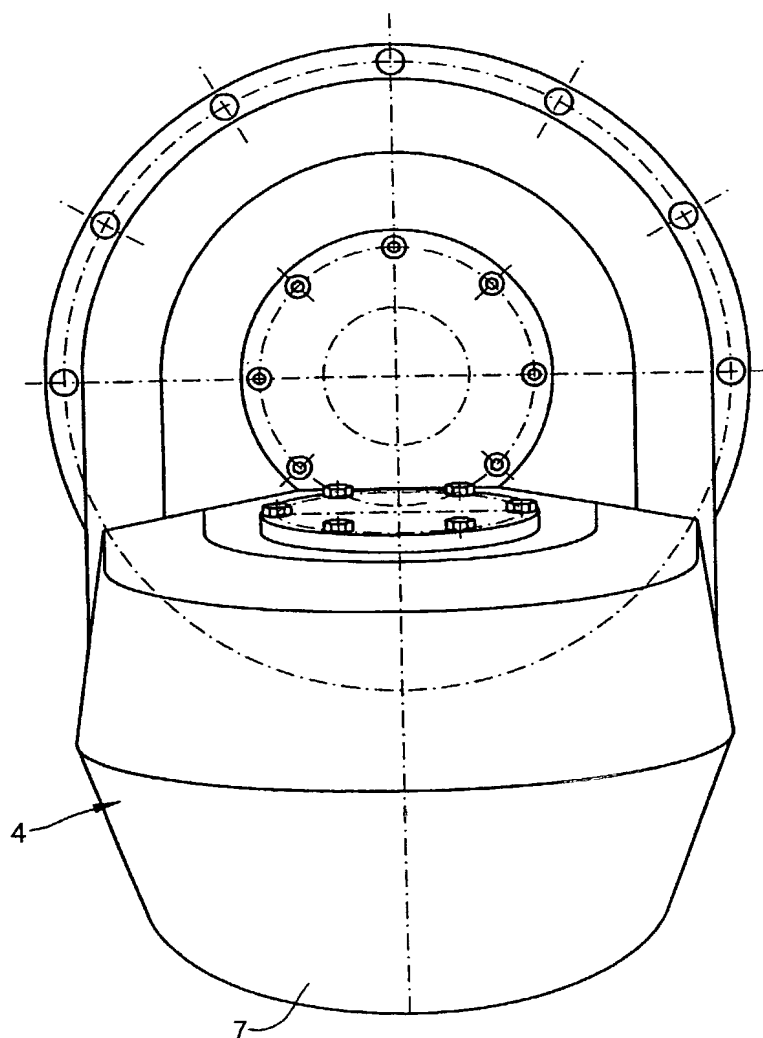
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Fig.2



3/4

Fig.3



4/4

Fig.4.1

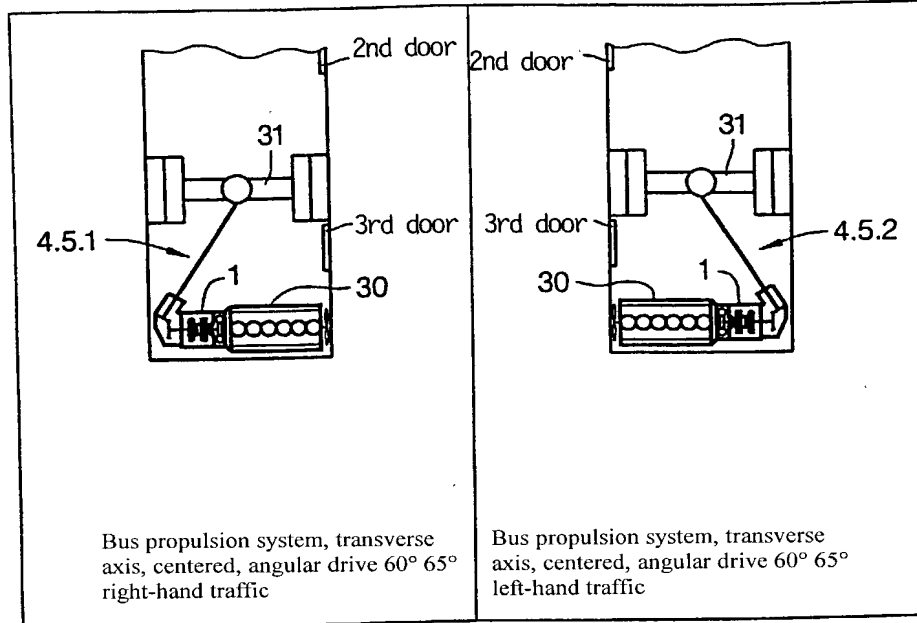


Fig.4.2

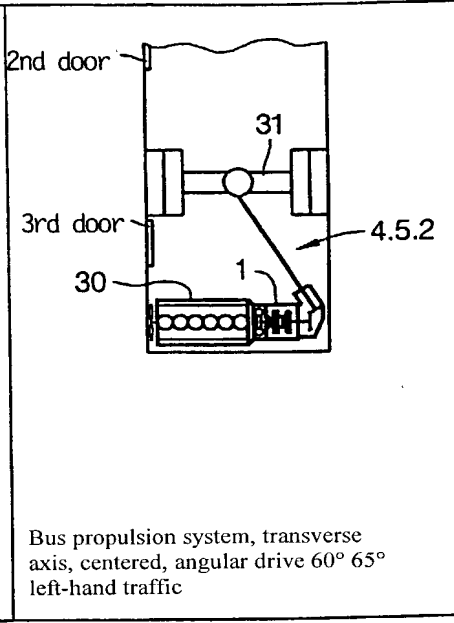


Fig.4.3

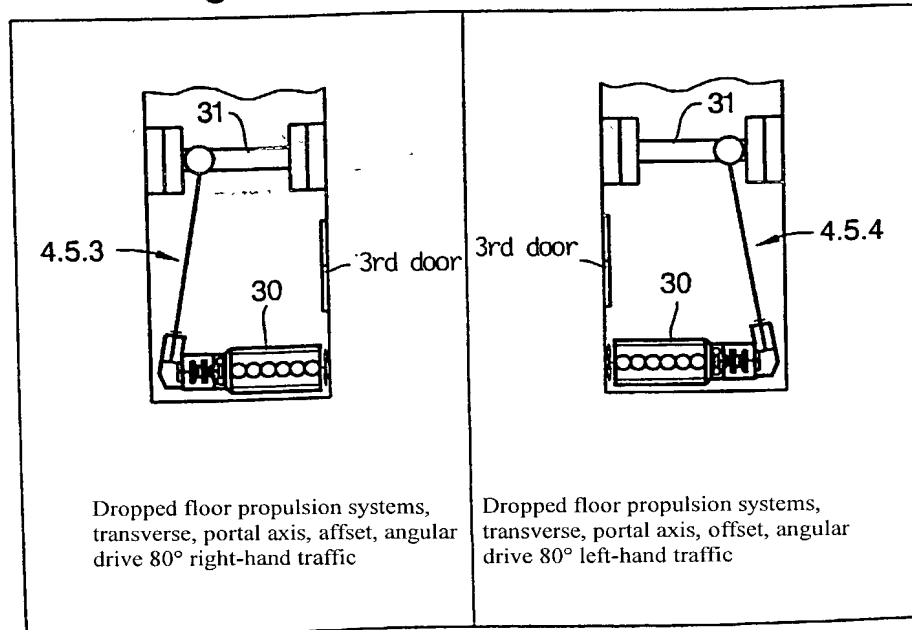
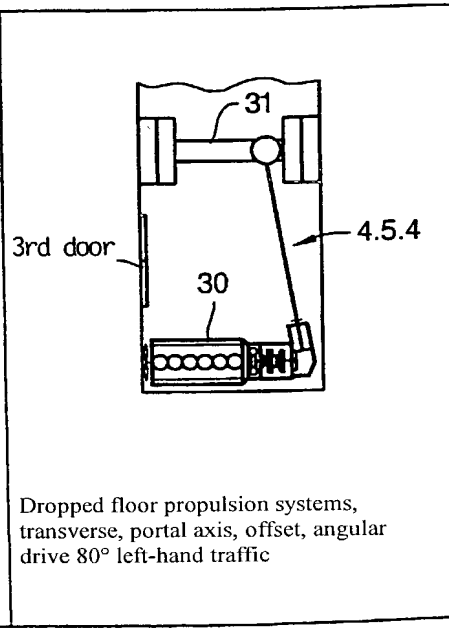


Fig.4.4



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- ☒ was filed on September 7, 2000
as United States Application Number or PCT
International Application Number PCT/EP00/08754
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Villmann Horner 02-04-23
Kern Peter Siebler 02-04-23

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(260) 460-1700

Vor- und Zuname des einzigen oder ersten Erfinders	1-00	Full name of sole or first inventor	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
		<u>Tillmann Körner</u>	
Wohnsitz		Residence	
		<u>Zang, Germany</u>	<u>DEX</u>
Staatsangehörigkeit		Citizenship	
		<u>German</u>	
Postanschrift		Post Office Address	
		<u>Weikersbergstrasse 42</u>	
		<u>89551 Zang</u>	
		<u>GERMANY</u>	
Vor- und Zuname des zweiten Miterfinders (falls zutreffend)	2-00	Full name of second joint inventor, if any	
Unterschrift des zweiten Erfinders	Datum	Second Inventor's signature	Date
		<u>Hans-Peter Eubler</u>	
Wohnsitz		Residence	
		<u>Heidenheim, Germany</u>	<u>DEX</u>
Staatsangehörigkeit		Citizenship	
		<u>German</u>	
Postanschrift		Post Office Address	
		<u>Oberer Erbisberg 37</u>	
		<u>89522 Heidenheim</u>	
		<u>GERMANY</u>	

(Im Falle dritter und weiterer Miterfinder Miterfinder sind die entsprechenden Informationen und Unterschriften hinzuzufügen.)

(Supply similar information and signature for third and subsequent joint inventors.)